I. INTRODUCTION

A new state of matter of deconfined quarks and gluons is created in the central Au+Au collisions at $\sqrt{s}=$ 200 GeV at RHIC. This matter exhibits strong collective flow, very low kinetic shear viscosity and is extremely opaque to the high energy jets traversing the matter. Instead of gas-like weakly coupled plasma, it is more like a fluid consists of strongly interacting quarks and gluons, hence strongly interacting quark-gluon plasma (sQGP).

One of the powerful tool to study the sQGP has been relied on the energetic jets and dijet correlations. However the medium is so opaque that these probes are very fragile. The observed high p_T single hadrons and correlated dihadrons come mainly from jets that suffer little energy loss, such as those emitted close to the surface or punches through the medium. Thus dynamical information about the energy loss process can not be directly inferred from observed single or di-hadrons. However,the energy of the quenched jets is redistributed in the medium to low p_T hadrons. This hadrons comes from the same jets would be correlated with each other in angular space. Such feedback contribution has been extensively studied experimentally[][][]. Arguablely, they are responsible for the away-side double hump structure in the away-side and the elongated ridge structure at the nearside. Such structures are shown to be important up to 4 GeV/c, above which the jet fragmentation of the surviving jets dominates.

The feedback could have large multiplicities, STAR's autocorrelation where no trigger particle were selected, shows that each particle could have about 7 correlated particles. Phobos also shows significant cluster size with mean multiplicity about 3.

Currently jet quenching calculation and feedback are modelled separately. Jet quenching calculation are typically applied purely for jet-jet correlation. Separate models are assumed for the feedback. Many models has been proposed as underlying mechanisms for this feedback[][]. However, separate mechanisms has been proposed for the near and away-side feedback, partly because their drastically different shape in $\Delta\phi$. Common wisdoms holds that the trigger particle come from jet, this jet is surface bias and loss a fraction of its energy and then fragments outside, the lost energy is responsible for the ridge. The away-side jet is absorbed by the medium most of the time, contributing to the shoulder yield, and occasionally escape the medium to contribute to pairs around $\Delta\phi sim\pi$, but is severely suppressed. However such a picture ignores an important contributor. Since the feedback is significant contributor up to 4 GeV/c comparing to jet fragmentation, instead of coming from jet fragmentation, the trigger particle could be one of the feedback particle. Also there is no surface bias at all, these particles comes many from quenched jets come from deep inside the medium.

In this paper, we include contribution dihadron from jet-jet, jet-medium, and medium-medium. We shows that medium-medium contribution could be important.

II. MODEL

We adopt the jet absorption picture of Ref.[], where the jet is assumed to loss all its energy after one interaction. Its energy loss probably basically can be written as

$$P(\Delta E) = a\delta(0) + (1-a)\delta(\Delta E - E)$$

This is simplified approach, but on the other hand, it was shown the data has little distinguishing power as long as they all tuned to match the single particle R_{AA}.

We made a simple extension to this model, in addition to calculate the jet survival probability which is proportional to $e^{-\kappa I}$, for the quenched jets, we assume it generated N_m correlated particle. Thus the average multiplicity induced by each jet can be written as

$$\langle N \rangle = N_{jet}e^{-kI} + N_{med}(1 - e^{-kI}) \qquad (1)$$

In the simulation, we generate the back-to-back dijet pairs according to the binary collision density profile $\rho_{Ncoll}(x,y)$. Their directions are randomly distributed in azimuth space. For each generated jet pair, we swim it through the medium with density proportional to participant density $\rho_{Npart}(x,y)$. If the jet survived, we convert it in to N_{jet} hadrons following a Guassian distribution around the original jet direction. Otherwise it is replaced by the N_{jet} jet-induced medium particles emitted at angle ± 1.1 from the original direction. We include both bending jet scenario, where all N_{med} are deflected to one side of the original jet, or mach cone scenario, where N_{med} are distributed equally to the both side of the original jet direction. The default parameter is $N_{jet} = 2$ and $N_{med} = 4$. This is motivated by the fact that the per-trigger yield is enhanced compared to p+p by factor of 3 in central collisions. However, due to swing of the away-side jet in η direction, only a fraction of the away-side jet falls in the detector acceptance. For the sake of the argument, we assume 30% of the particles from away-side jet are detected.

We then constructed dihadron correlation by combining all possible pairs based on all the particles from the original dijet. The total number of pairs would be $(N_1 + N_2)(N_1 + N_2 - 1)/2$, where N_1 and N_2 are number of particles from the two jets respectively. In the default set up, $N_{1,2}$ is 2 or 4 depending it is coming form jet fragmentation or medium feedback. They can be decompose into three types of pairs: jet-jet, jet-medium or medium-medium pairs. jet-jet refers to pairs where the two hadrons comes from jets; jet-medium refer to pairs where one hadron from jet, the other hadron from medium feedback; medium-medium refers to pairs where both hadrons comes from medium feedback. Clearly, since jet can either survive or contribute to feedback hadrons, The jet-medium contribution always comes from different jets. Both jet-jet and medium-medium contains pairs from same jet or opposite jets.

In pure jet quenching model, only jet-jet is considered. In the medium response models, jet-medium contribution is added. But here we want to investigate the rule of medium-medium contribution.

In central Au+Au collisions, since 80% of the jet is quenched (absorbed here). One could imagine medium-medium contribution would naturally dominates. Figure 1 shows the centrality dependence of the pairs coming from the three sources. The three distribution is normalized to pairs from every di-jet pairs. In peripheral Au+Au or p+p cases, the pairs are dominated by jet-jet pairs, thus total pairs is about 3.2. This contribution then decrease with increasing N_{part}. In central Au+Au collisions, most of the jets are quenched, most of the pairs comes from medium-medium contribution, which gives a total pair yield about 16.8. The total amount of cross pairs from jet-medium, first increases shapely with centrality, but then decreases slowly due to strong quenching of the single jet yield.
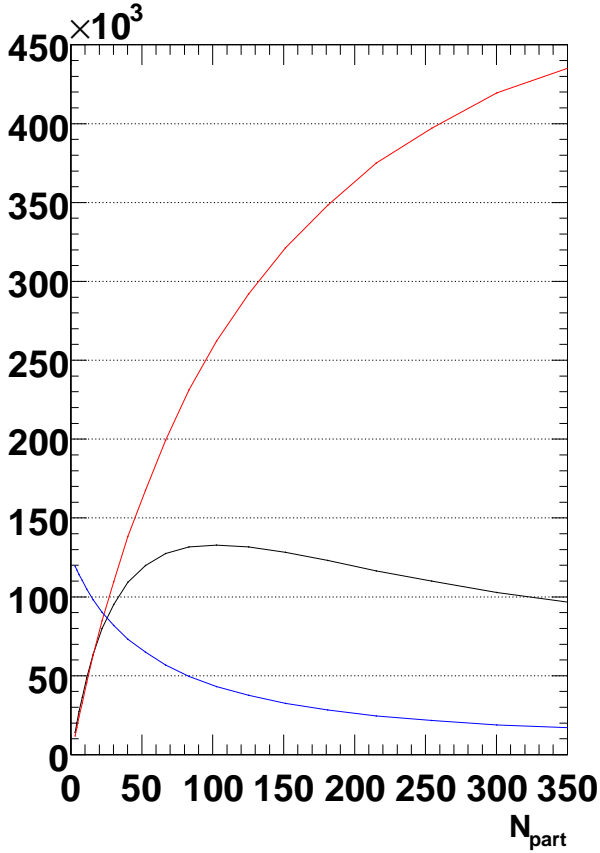
FIG. 1: The jet pair yield contributed form jet-jet, jet-medium and medium-medium sources.

Next step, we want to be able to reproduce the shape of the $\Delta\phi$ distribution for dihadrons. The following variables are introduced: σ_{jet} the jet fragmentation width, σ_{med} the angular spread of the around D for medium particles; f, the fraction contribution from bending jet scenario over the total medium-medium contribution;σ_{jetkt} the away-side jet broadening due to initial state k_T smearing. We fix the σ_{jet} and σ_{jetkt} based on the $p+p$ and d+Au data from at around 2 GeV/c for partner p_T, which is 0.3 and 0.5 radian, respectively. σ_{med} is fixed to 0.3 radian according to the data in[].

Figure shows the $\Delta\phi$ distribution from bending jet scenario (left panel) and mach cone jet scenario (middle panel) and the sum (right panel). We show separately the contributions from the inter-jet and intra-jet pairs. The contribution from bending jet has a large but broad jet peak around $\Delta\phi \sim 0$, this can be interpreted as the contributions from pairs from the same jet. The pairs from the different jet shows a small peak at around $\Delta\phi \sim \pi$, but also shows two small satellite peaks on the near-side, they comes from particles from different jet but falls on the same hemi-sphere. The contribution from Mach cone type of scenario are very different. The pairs from same jet splits up into three equal sized branches: one centered around $\Delta\phi \sim 0$, two centered around $\Delta\phi \sim \pi \pm 1.1$ at the away-side. The pairs from different jets are centered around $\Delta\phi \sim \pi$ with somewhat significant magnitude and two small satellite peaks around $\Delta\phi \sim \pm1.1$. In both cases, the contribution from different jets are suppressed since there is only 30% of them falls in the acceptance.

With a mixture of 1/4 bending jet and 3/4 of cone jets, the sum of the distributions are shown in the left panel of Figure. The total distribution already looks much like the normal dihadron distribution, with a double peak structure on the away-side.

In the same framework, we can also calculation the contribution from traditional sources, jet-jet and jet=medium contribution. The results are shown in Figure.